





# Groundwater Transport: Handbook of Mathematical Models (1984)

Water Resources Monograph Series 10

I. Javandel, C. Doughty, and C. F. Tsang, Editors  
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## News (cont. from p. 411)

been made on surveys of the Atlantic Ocean EEZ.

Both agencies encourage concurrent "piggyback" observations and sampling during these cruises. Several existing NOAA programs (NBT, SST, weather and fisheries observations, and water pumping and chemical analyses for NOAA's acid rain program) will participate in this manner. Observations must generally be compatible with underway operations, but a limited number of onstation operations may be possible. Investigators wishing to take advantage of this ship time with a compatible experiment are encouraged to obtain further information from Donald E. Pryor, Project Manager (telephone: 301-443-5875). Submit written proposals to Adm. John Bossler, National Ocean Service, NOAA, 6001 Executive Boulevard, Rockville, MD 20852 (telephone: 301-443-8204).

This news item was contributed by Donald Pryor, National Oceanic and Atmospheric Administration, Office of Charting and Geodetic Services, Rockville, MD 20852.

## IRAS: Other Planetary Systems

The search is on. After IRAS (Infrared Astronomy Satellite) resolved cool (85 K), thermally emitting masses apparently in orbit around the hot (10,000 K) star Vega during the spring of 1983, considerable efforts have been made to identify other solar systems and planets. Right now observers accept any size planets, even 20 p diameter orbiting particles as in the case of the Vega system, as a step in the direction that could conceivably lead to discovery of a solar system like our own. (See Eos, March 13, 1984, p. 97.)

In December 1983, IRAS results had been processed further. Among the many results, IRAS had found another solar system, again probably with only protoplanets. The star Formicula, like Vega, a well-known navigational aid, has a similar protoplanetary system.

These discoveries were made by infrared black-body emission spectrum analysis and remarkably well resolved spectrally. The resolution of IRAS is obtained by means of four arrays of infrared filtered detectors obtaining wavelengths that extend discontinuously from 12 to 100  $\mu$ m. The observational aperture of IRAS is not comparable to that of earth-based systems, so there was not the available angular resolution to map out details of the protoplanetary systems as could be done by telescope. IRAS only lasted less than 1 year, as its supply of cryogenic liquid helium evaporated away.

A recent discussion of results of a conference on protoplanetary systems suggests that ground-based telescopes are now involved in the search as well (Physics Today, May 1984). Telescopes at Kitt Peak, Arizona, and Mauna Kea, Hawaii, have found several protoplanetary systems recently, and a few more were reported by the IRAS group. The ground-based telescopes are limited by wavelengths observable (2–4  $\mu$ m), atmospheric turbulence, water vapor, and thermal emission. They have larger viewing angles, however, and can get down to an aperture of as low as one-tenth arc second. The systems employ speckle interferometry techniques.

The importance of the observations is now being realized. Some of the observations have been confirmed independently by the Kuiper

Airborne Observatory, which is a NASA-operated aircraft with telescope. This evidence is considered the first direct discovery of the existence of nonstellar material in orbit around a star outside of our solar system.—PMB

## NSF Director To Resign

Edward A. Knapp, director of the National Science Foundation (NSF) since late 1982, will resign his post later this year to return to research at the Los Alamos National Laboratory. President Ronald Reagan has announced his intention to nominate Erich Bloch, vice president for technical personnel development at the IBM Corp., as Knapp's successor.

Following formal nomination by President Reagan, the Senate must confirm Bloch as NSF director. If Bloch is confirmed, he is likely to bring to NSF the greater emphasis on engineering that the agency has sought in response to requests from Congress and the engineering community during the last year. Knapp will return to Los Alamos to continue his research in high-energy physics. He has not specified when he will leave NSF, according to an agency spokesman, but has told the Administration that he would like to leave as soon as possible. Knapp was nominated for the top NSF post on November 2, 1982, and was confirmed by the Senate on April 15, 1983 (Eos, May 10, 1983, p. 372).

Bloch was recommended by the National Science Board, the policymaking arm of NSF. Board Chairman Roland W. Schmitt expressed regret over Knapp's impending departure, noting that Knapp "has made numerous contributions to the nation's scientific and engineering health during his 2 years with the foundation." Schmitt said that during those 2 years, NSF's budget has increased 38%. "A number of important new initiatives, such as in science and engineering education, in strengthening engineering research in academic institutions, and in strengthening academic careers for young investigators, have been started," Schmitt added. "He has ably reflected and carried out the objectives of the Administration and the Congress."

"In recommending Erich Bloch for the NSF post, we feel confident that we have selected a worthy successor, who will continue the NSF's tradition of support to the nation's scientific and technical goals," National Science Board's Schmitt said.

Bloch, a native of Sulzberg, Germany, and a naturalized U.S. citizen, has been at IBM since 1952, when he joined the company as an electrical engineer. He has held several managerial positions at IBM, including assistant group executive for technology, director of subsystems and technology, and vice president for operations. He was elected a vice president of IBM in 1981.—BTR

## In Congress: Year of Ocean

On June 8, the U.S. Senate passed a resolution (S.J. Res. 257) proclaiming the year beginning July 1, 1984, as the Year of the Ocean. The resolution has been sent to the House of Representatives for its consideration.

The resolution echoes the title and the ob-

jectives of the national celebration of the oceans and their products, slated to begin on July 1 with Ocean Day (Eos, April 24, 1984, p. 386). Specifically, the resolution requests President Reagan to issue a proclamation calling upon the people of the United States to observe such a celebration with appropriate activities.

Another House-initiated resolution (H.J. Res. 478), which designated the week of April 29 to May 5, 1984, as National Week of the Ocean, was signed into law (P.L. 98-274) on May 7.—BTR

## Mercury in the Atmosphere

A source of atmospheric mercury, which appears to be associated with marine biological activity, has been located in the equatorial region of the Pacific Ocean. A recent report of a study of mercury and its compounds confirm models of oceanic sources of mercury to the marine troposphere, but suggest that the process involved may be a good deal more complex than previously thought. W. F. Fitzgerald, G. A. Gill, and J. P. Kim wrote in Science (244, 597-599, 1984) that their results "... demonstrate that Hg interactions between the oceans and atmosphere are more complex than geochemical mass balance estimates suggest."

Data obtained during the research cruise of the University of Washington's R/V, T. G. Thompson, during October 1980 included shipboard determinations of total gaseous mercury (TGM) from the atmosphere and determinations of reactive mercury from mixed layer water samples. The results suggest that the upwelling and its associated biological activity in the equatorial zones (4°N to 10°S) may be responsible for the observed atmospheric enhancement of TGM. Both algae and bacteria are known to be able to convert dissolved mercury to volatile vaporous compounds, although neither the kind of organism nor the specific process of mercury release were identified in the study. The link between the measurements of mercury and a marine biological source was just the observed geographic juxtaposition.

The actual compounds were not identified. It was suggested that they could be in the form of an organomercury compound like dimethyl mercury. This is one of the forms of mercury in the group of compounds that are known to be synthesized biologically.—PMB

## In Congress: Upcoming Hearings

The following hearings and markups have been tentatively scheduled for the coming weeks by the Senate and House of Representatives. Dates and times should be verified with the committee or subcommittee holding the hearing or markup; all offices on Capitol Hill may be reached by telephoning 202-224-3121. For guidelines on contacting a member of Congress, see AGU's Guide to Legislative Information and Contacts (Eos, April 17, 1984, p. 159).

June 26: Hearing on the National Minerals and Materials Policy Coordination Act (H.R. 3717) by the Mining, Forest Management, and Bonneville Power Administration Subcommittee of the House Interior and Insular Affairs Committee. Longworth Building, Room 3224, 9:45 A.M. (Date changed from June 25.)

TBA: Conference committee on legislation to consolidate and authorize atmospheric and satellite programs of the National Oceanic and Atmospheric Administration. Time and date to be announced. House conferees: Fuqua (D-Fla.), Scheuer (D-N.Y.), Valentine (D-N.C.), Harkin (D-Iowa), Andrews (D-Tex.), Jones (D-N.C.), D'Amours (D-N.H.), Winn (R-Kan.), McGrath (R-N.Y.), Schneider (R-Ill.), and Carney (R-N.Y.). Senate conferees to be announced.—BTR

## Recent Ph.D.'s

Eos periodically lists information on recently accepted doctoral dissertations in the disciplines of geophysics. Faculty members are invited to submit the following information, on institution letterhead, above the signature of the faculty advisor or department chairman:

- (1) the dissertation title,
- (2) author's name,
- (3) name of the degree-granting department and institution,
- (4) faculty advisor,
- (5) month and year degree was awarded.

If possible, include the current address and telephone number of the degree recipient (this information will not be published).

Dissertations with order numbers, and many of the others listed, are available from University Microfilms International; Dissertation Copies, P.O. Box 1764, Ann Arbor, MI 48106.

A Decision Support Model for the Investment Planning of the Remediation and Rehabilitation

of Marine Water Distribution Systems, F. Kara, Dep. of Civil Eng., Mass. Inst. of Tech., June 1984.

A Fully Internal Hybrid Technique for Calculating Electromagnetic Scattering from Three Dimensional Bodies of the Earth, W. R. Petrick, Dep. of Geol. and Geophys., Univ. of Utah, March 1984.

A Geochemical Appraisal of Oxidation-Reduction Potential and Interpretation of Eh Measurements of Ground Water, R. D. Lindberg, Dep. of Geol. Sci., Univ. of Colo., December 1983.

A Heat-Flux Investigation of the Lepontine Alps, in the Valle Maggia Region, Ticino Canton, Switzerland, R. Nolen-Hoeksema, Dep. of Geology and Geophysics, Yale Univ., May 1983.

A Paleomagnetic Study of the Prince William Terrane and Nisam Fork Terrane, Alaska, P. W. Plumley, Dep. of Earth Sciences, Univ. of Calif., Santa Cruz, March 1984.

A Parametric Wind-Wave Model for Arbitrary Water Depths, H. C. Graber, Dep. of Civil Eng., Mass. Inst. of Tech., June 1984.

A Spectroscopic and Chemical Study of the Coloration of Feldspars by Irradiation and Impurities, Including Water, A. M. Hofmeister, Geological and Planetary Sciences, Calif. Inst. of Tech., June 1984.

A Three-Dimensional Finite Element Model for Mantle Convection, J. R. Baumgardner, Dep. of Earth and Space Sci., Univ. of Calif., December 1983.

An Experimental and Theoretical Study of Supercritical Fluids in Non-cohesive Sediments, C. F. McLane, III, Dep. of Environ. Sci., Univ. of Va., May 1984.

Analysis of Upper and Low Mantle Structure Using Shear Waves, T. Lay, Seismological Lab., Div. of Geological and Planetary Sciences, Calif. Inst. of Tech., March 1983.

Applications of Teleseismic Body Waves to Shallow Earth Structures, J. P. Sclafani, Dep. of Geophysics, Stanford Univ., April 1984.

Be-10 in the Atmosphere and Soils, M. O. Munaghan, Dep. of Geology and Geophysics, Yale Univ., May 1984.

Chemistry of Submarine Hydrothermal Solutions at 21°N, East Pacific Rise and Guaymas Basin, Gulf of California, K. L. Von Damm, Mass. Inst. of Tech., February 1984.

Constraints on the Earth's Anelastic and Athermal Structure from Antipodal Surface Waves, E. P. Chael, Seismological Lab., Div. of Geological and Planetary Sciences, Calif. Inst. of Tech., May 1983.

Energy Release in Earthquakes, and Subduction Zone Seismicity and Stress in Slabs, M. S. Vassiliou, Seismological Lab., Div. of Geological and Planetary Sciences, Calif. Inst. of Tech., March 1983.

Evolution of the Porphyry Copper and Shale Deposits at Mudochville, Gaspé Peninsula, Quebec: A Geochemical, Stable Isotope, and Fluid Inclusion Study, K. L. Shelton, Dep. of Geology and Geophysics, Yale Univ., May 1982.

Geology and Eruptive Mechanisms of Masap Caldera Complex, Nicaragua, S. N. Williams, Dep. of Earth Sciences, Dartmouth College, June 1983.

Groundwater Right Protection and Aquifer Development Management: Administrative Approaches in the Western United States, J. L. Emel, Dep. of Hydrol. and Water Res., Univ. of Ariz., December 1983.

Heterocyclics in Ground Water, J. H. Randall, Dep. of Hydrol. and Water Res., Univ. of Ariz., December 1983.

Holographic In-Situ Stress Measurement in Geophysics, S. N. Cohn, Seismological Lab., Div. of Geological and Planetary Sciences, Calif. Inst. of Tech., June 1983.

Impacts of Groundwater Management and Alternative Irrigation Technologies on Water Conservation in Pinal County Agriculture: An Economic Analysis, I. A. Akporobi, Dep. of Hydrol. and Water Res., Univ. of Ariz., December 1983.

Increases and Fluctuations in Thermal Activity at Mount Wrangell, Alaska, R. J. Motyka, Dep. of Geol. and Geophys., Univ. of Alaska, December 1983.

Intergranular Fluid Distribution in Olivine-Lite Basalt Systems, J. R. Pula, Dep. of Geology and Geophysics, Yale Univ., May 1982.

Interpretation of Near-Surface Ground Motion and Implications, Hui-Lin Liu, Seismological Lab., Div. of Geological and Planetary Sciences, Calif. Inst. of Tech., May 1983.

Inversion of Body-Wave Seismograms for Upper Mantle Structure, J. W. Given, Seismological Lab., Div. of Geological and Planetary Sciences, Calif. Inst. of Tech., July 1983.

Long Period Regional Body Waves, T. C. Wallace, Jr., Seismological Lab., Div. of Geological and Planetary Sciences, Calif. Inst. of Tech., March 1983.

Meteorite Concentrations and Glaciological Parameters in the Allan Hills Icefield, Victoria Land, Antarctica, J. O. Annaxstad, Johannes Gutenberg-Universität, Mainz, W-Germany, November 1983.

Mineral Transformations During Rock Weathering, and Geochemical Mass Balances in Forested Watersheds of the Southern Appalachians, M. Veibel, Dep. of Geology and Geophysics, Yale Univ., May 1984.

Mineralogy, Petrology, and Geochemistry of the Sangre de Cristo Volcanic Complex, Mt. C. Collinson, in the Mojave Sea, Indomine, M. G. Morris, Univ. of Calif., Santa Cruz, December 1982.

Modeling the Interactions of Trade Winds and Aquatic Home Materials, W. Bush, Dep. of Civil Eng., Mass. Inst. of Tech., June 1984.

# Books

## Underground Sound: Application of Seismic Waves

J. E. White, *Methods in Geochemistry and Geophysics*, vol. 18, Elsevier, New York, 1983, xvi + 254 pp., \$59.50.

Reviewed by Thomas R. Morgan

J. E. White concerns himself, as stated in the Introduction, with naturally and artificially generated seismic waves, the properties of the rock they travel through, and the methods used to generate and detect them. He discusses these in terms of models of earth materials which can include the effects of porosity, layering, direction of travel, loss mechanisms, and a number of other phenomena. Although the emphasis is definitely on borehole methods, attention is given to surface problems, and many of the data examples cited are surface recordings.

Some needed mathematical tools, such as Fourier transforms and convolution, are briefly introduced in chapter 1. For the most part, his stated aim is to avoid the use of vector operators and tensor notation, although the lack of these methods may cause some readers to have difficulty connecting specific relations with general presentations from other sources. He steadfastly sticks to this goal, but the book is still laden with imposing math. Following in chapter 2 is a general discussion of plane waves and plane boundaries. This section covers the groundwork with which most readers will be very familiar.

The meat of the effort is contained in chapters 3–6, which break the subject matter into four logical areas: models of earth materials, loss mechanisms and attenuation, waves in boreholes, and sources and receivers. Each area contains a great deal of mathematical detail and covers the topic thoroughly. He pays close attention in his arguments to such fundamentals as causality and the physical meaning of boundary conditions. Also appreciated is his use of experimental evidence for many of the earth models introduced.

The analysis of the borehole problem goes deeply into the ramifications of the three-dimensional, elastic, and even anisotropic behavior of the earth. The practical details were greatly appreciated by one who has concentrated on the surface seismic exploration problem, where we are just beginning to move into consideration of three-dimensional and non-acoustic models. He provides numerous insights about sources and receivers, earth materials, and alternate coordinate systems.

Many of these have not been given the careful attention they deserve in modeling and interpretation of surface reflection seismic records. As computer costs and computation times drop, and other areas of seismic exploration move toward more realistic earth models, we should be able to learn and adapt much from the borehole theory presented here.

The seismic exploration industry is beginning to slowly accumulate reference sources that are more narrowly directed toward individual disciplines. These sources are making the connection from more theoretical and general references to the specific classes of applied field problems, which are, in a sense, "economic geophysical" problems. The intended audience has shifted toward exploration professionals and advanced graduate students rather than to undergraduates as many texts of the previous generation tended to be. This effort fits a vital gap.

Thomas R. Morgan is with O'Connor Research, Inc., Denver, CO 80202.

## The Great Tolbachik Fissure Eruption: Geological and Geophysical Data 1975–1976

S. A. Fedotov and Ye. Markhinin, (Eds.), Cambridge Univ. Press, New York, 1983, xii + 341 pp., \$69.50.

Reviewed by Robert I. Tilling

In this decade, the devastating eruptions of Mount St. Helens in May 1980 and of El Chichón (Mexico) in March-April 1982, along with recurring signs of possible precursory activity at Long Valley caldera (California), have greatly increased public as well as scientific awareness of volcanic phenomena. Yet, even though the Great Tolbachik Fissure Eruption (GTFE) in 1975–1976 was larger than any in the world thus far in the 1980's, it received scant notice outside the USSR because of its remote location in the Kamchatka Peninsula (off limits to westerners) and because initial reports of it were almost exclusively in Russian. This new book, edited by Fedotov and Markhinin, now makes available to the western world information regarding the GTFE, the biggest volcanic event in the 1970's. Moreover, it was the largest basalt eruption in the Kurile-Kamchatka arc in recorded history and, on a global basis, the

most voluminous outpouring of basalt since the 1783 Laki fissure eruption in Iceland.

Ploskiy Tolbachik is part of the Klyuchevskaya group of volcanoes in central Kamchatka, an imposing truncated conical structure that rises about 2000 m above its surroundings. It is the only basaltic volcano in Kamchatka and behaves much like the intraplate shield volcanoes in Hawaii, in spite of its location in a convergent-plate tectonic setting. Extending from its summit are broad NE- and SSW-trending zones (containing abundant open fissures, cinder cones, and vents) structurally analogous to the "rift zones" of Kilauea and Mauna Loa Volcanoes in Hawaii. Before the 1975–1976 activity, the summit caldera contained a pit crater, about 300 m wide and 150 m deep, in which a lava lake was periodically active.

The GTFE began the morning of July 6 from a fissure vent in the SSW-rift zone about 18 km from the summit, following an intense seismic swarm June 27 to July 5. Vigorous activity at this site (later called Northern Breakthrough) continued until September 15, during the course of which were produced 8–12 km high eruption columns, voluminous lava flows, and three cinder cones with heights of 330, 300, and 150 m. The volume of materials erupted during this period was about 1.3 km<sup>3</sup>.

Preceded by another strong seismic swarm (September 1–17), the eruption resumed on September 18 along a 600 m fissure about 10 km southwest of the Northern Breakthrough. By the next day, vent activity became concentrated near the southern end of the fissure. Eruptive activity, predominantly extrusive but intermittently explosive, in this area (the Southern Breakthrough) then continued virtually nonstop until December 10, 1976. The eruptive style at the Southern Breakthrough was "Hawaiian" and included "curtains of fire," lava fountains, pahoehoe and aa flows, and lava tubes. An additional 0.5–0.7 km<sup>3</sup> of basalt was erupted, bringing the total volume erupted to about 2 km<sup>3</sup>.

The shift of activity from the Northern to the Southern Breakthrough was preceded by major collapse in early August 1975 of the preexisting summit crater of Ploskiy Tolbachik. Piece-meal collapse of the summit crater persisted until the end of 1975, enlarging it to a diameter of about 1.7 km and a depth of 0.5 km or more. Seismic and geochemical data suggest that the magmatic and eruptive processes operative during the GTFE seem to closely resemble those for many Hawaiian eruptions, despite widely contrasting plate-tectonic settings for Hawaii and Kamchatka.

Because analysis of seismic data predicted the GTFE eruption several days in advance,

the Institute of Volcanology of the Academy of Sciences of the USSR was able to field a small, multi-discipline team of scientists to expand the seismic network, to begin the task of establishing other monitoring networks, and to visually and photographically document the eruption from the start. The results of ensuing systematic studies of the entire eruption were published in Russian in 1978 as a symposium volume (*Geologicheskoye i geofizicheskoye dannoye o Bol'shom treschinnom izvreshenii 1975–1976 gg.*, Nauka Press, Moscow).

The present book is a superb and quite readable translation of the 1978 symposium volume, by the Cambridge Arctic Shelf Programme translation team. It consists of 25 papers summarizing the results of geologic, geochemical, and geophysical studies, not only of the GTFE itself but also of the general geology, tectonics, petrogenesis, and crustal studies of the Tolbachik region. An additional interesting paper describes the establishment in 1955, and subsequent growth, of the Kamchatka Volcanological Station, which ranks among the world's best volcano observatories.

Although the legitimacy of some of the illustrations could be improved, most are excellent and informative; an index for the text, as well as a large-scale index map of Ploskiy Tolbachik and vicinity, would aid the reader and should be considered for subsequent editions of the book. The prediction of the GTFE is alluded to in several papers, but nowhere in the book is given the information or reference(s) regarding its basis and statistical uncertainty, when the prediction was made, and how it was communicated to authorities and the public. The inclusion of a paper specifically discussing the reportedly successful prediction would have further increased the usefulness of the book and would have advanced the embryonic science of volcanology, in which most eruption forecasts and predictions are still more art than science.

The publications of this book provides to the non-Russian reading volcanologists and other interested scientists a valuable data base for one of the most significant volcanic eruptions in recent decades. The book contains much grist for evaluation of models of basaltic volcanism at convergent plate boundaries. In particular, it should spur comparative studies of the processes of the generation, storage, transport, and eruption of basaltic magma in diverse tectonic settings. Clearly, any serious student of volcanism should acquire, or have access to, this useful and informative volume.

Robert I. Tilling is with the U.S. Geological Survey, Reston, VA 22092.

# Classified

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## POSITIONS AVAILABLE

Research Associate/University of Maryland. The Space Physics Group of the Department of Physics and Astronomy has an opening for a Research Associate beginning in early 1984 for an initial one-year period with high likelihood of extension. The position involves research on energetic particles of solar and interplanetary origin. Applicants should have knowledge of, and interest in, at least one of the following areas: solar-wind magnetosphere interactions, magnetosphere-ionosphere coupling, ionosphere-atmosphere coupling, collisionless plasma electrodynamics, atmospheric electricity, space and/or interplanetary ionospheric modeling is an important consideration. Title and salary level commensurate with experience, ranging from one-year Research Associate (renewable in subsequent years depending on performance) to open-ended Research Scientist appointment in the Center for Space Physics. Please send resume and names of three professional references to T. W. Hill or R. A. Wolf, Space Physics and Astronomy Dept., Rice University, Houston, TX 77251.

The University is an equal opportunity/affirmative action employer.

Physical Oceanographers. The Marine Life Research Group of the Scripps Institution of Oceanography invites physical oceanographers to apply for a research position. The research equivalent of the professional series (Ph.D. or equivalent required), to study the circulation of the California current and eastern north pacific, support is offered for two years. After which the candidate may be expected to generate all or part of continuing support.

Salary range \$25,100–49,900. Level of appointment to be based on qualifications. Position start date: September 1984.

Please send resume and at least three references to Director, Marine Life Research Group, A-050, Scripps Institution of Oceanography, La Jolla, California 92037 or August 1, 1984.

The University of California, San Diego is an equal opportunity/affirmative action employer.

Marine Organic Geochemist. The Department of Oceanography, Old Dominion University, seeks candidates for a newly created, tenure track assistant professor level position in marine organic geochemistry. Specific research interest is open, although the major departmental emphasis is on coastal process. The successful candidate is expected to pursue a vigorous funded research program, and to teach graduate and/or undergraduate level courses in his/her field. A Ph.D. is required and post doctoral experience is desirable. The expanding Oceanography Department offers programs leading to the M.S. and Ph.D. degrees. It currently has 15 faculty positions, with three in chemical oceanography, 70 graduate students, and the appropriate facilities for many chemical studies. The position is available immediately. Applicants should submit via statement of research interests, and the names of three references by August 1, 1984 to Gregory A. Cutter, Search Chairman, Department of Oceanography, Old Dominion University, Norfolk, VA 23508. 804-440-4285.

Old Dominion University is an affirmative action/equal opportunity institution.

Research Position-Space Physics/Rice University. The Space Physics and Astronomy Department at Rice University seeks applicants for one or more full-time research positions within the department. Successful applicants will play key roles in the development of theoretical three-dimensional models of the Earth's electromagnetic field. Applicants should have knowledge of, and interest in, at least one of the following areas: solar-wind magnetosphere interactions, magnetosphere-ionosphere coupling, ionosphere-atmosphere coupling, collisionless plasma electrodynamics, atmospheric electricity, space and/or interplanetary ionospheric modeling is an important consideration.

Title and salary level commensurate with experience, ranging from one-year Research Associate (renewable in subsequent years depending on performance) to open-ended Research Scientist appointment in the Center for Space Physics. Please send resume and names of three professional references to T. W. Hill or R. A. Wolf, Space Physics and Astronomy Dept., Rice University, Houston, TX 77251.

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Postdoctoral Position/Meteorology. Postdoctoral position in meteorology, full time, federal funds, salary commensurate with qualifications.

Duties: Participate in climate and dynamics studies of the Pacific Ocean region and its interaction with other regions.

Qualifications: Computer data processing skills; some tropical and air-sea interaction experience; or training desirable. To apply, send resume to Dennis W. Moore, Director, Joint Institute for Marine and Atmospheric Research (JIMAR), University of Hawaii, 1000 Pope Road, Honolulu, Hawaii 96822. Telephone 808-948-8008. Closing date: July 31, 1984.

An Equal Opportunity Employer.



**Research Associate/Research Technician.** The University of Maine at Orono (UMO) has an opening for a research associate/research technician who would work in a small geophysical group. We seek an individual who can use and maintain modern digital electronic equipment; for example, multi-channel analyzers, 10 interfaces for microcomputers, digital plotters and digitizing tables. Familiarity with BASIC and FORTRAN will be needed, and some geophysical field work may be required as part of the duties of the appointee. Current funding permits an appointment for at least 12 months. Subject to arrival of anticipated funding, the appointment period could be extended to two years, or longer. Call Edward R. Decker at 207-581-2158 or 207-581-2152 about the position. Send inquiries, a vita and a list of at least three references to Edward R. Decker, Department of Geological Sciences, 110 Boardman Hall, University of Maine at Orono, Orono, ME 04469.

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**Hydrogeologist.** Applications are invited for a non-tenure track academic research appointment in hydrogeology to be filled at the instructor or assistant professor level. This position will have broad research responsibilities in one or more of the following areas: regional and site-specific hydrogeological studies, hydrogeologic and hydrochemical aspects of surface coal mining and reclamation, and assessment of aquifer characteristics by aquifer testing and hydrochemical evaluation. The position entails considerable field work and will be located in Billings, Montana. Candidates must have a M.S. degree in hydrology or geology (Ph.D. preferred) and at least three years of hydrogeologic experience with emphasis on aquifer testing and related work. Knowledge of drilling and the geology of northeastern Montana preferred. The closing date for applications is June 22, 1984. Salary will be \$24,000-\$32,000, depending on education and experience. Applications with resume and names and telephone numbers of three references should be sent to: Director, Montana Bureau of Mines and Geology, Montana College of Mineral Science and Technology, Butte, MT 59701.

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**Postdoctoral Research Associate Position/Geophysics and Igneous Geochemistry.** The University of Maine at Orono (UMO) has postdoctoral openings for a solid earth geophysicist and an igneous geochemist. We seek a geophysicist who wishes to advance fundamental understanding of past and current thermal histories of the Appalachian Orogen in New England and elsewhere. The geochronologist would be expected to investigate volcanic and plutonic suites in the Appalachians in Maine and in other terranes. Current funding permits appointments for at least 12 months. Subject to arrival of anticipated funding, the appointments could be extended to two years. Both appointments could start as early as August 1, 1984. Excellent facilities for geochronological research, computer applications, petrologic research and geochemical studies exist at UMO. Additionally, limited funds are available for travel and research, and the appointees will be encouraged to generate exterior support individually or through cooperation with existing faculty. Please send inquiries, a vita, a list of references, and a description of research interests to Edward R. Decker or Daniel R. Cox, Department of Geological Sciences, 110 Boardman Hall, University of Maine at Orono, Orono, Maine 04469. Telephone calls may be made to 207-581-2158, and forwarded to Decker or Cox.

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**Texas A&M University/Sediment Stratigraphy.** The Department of Oceanography in the College of Geosciences at Texas A&M University has an opening for a Ph.D. with specialization in the field of sediment stratigraphy. This tenure track position is at the assistant professor level. Salary is negotiable depending upon experience and qualifications. This position will include teaching and supervising graduate students. The successful applicant will be expected to teach undergraduate courses in general oceanography, a graduate course in sediment stratigraphy, and may develop graduate courses of his/her own design. He or she will also be expected to conduct a vigorous research program.

Applicants should submit a vita along with a letter describing his/her research and teaching goals and the names of five persons for reference to Professor

Robert O. Reid, Head, Department of Oceanography, Texas A&M University, College Station, Texas 77843. The closing date for applications is 15 July 1984.

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**Senior or Senior Project Hydrogeologist/Hydrologist.** A newly-formed hydrogeology and engineering consulting firm, The Mark Group, seeks a mature, experienced hydrogeologist or hydrologist for an immediate filling of a senior technical position in the Las Vegas office. Ongoing and projected investigations will emphasize water resources development, hazardous waste, and geotechnical engineering projects. Principal project work is in California, Nevada and Arizona. Prefer applicants with minimum four years similar experience and M.S. degree from a recognized program. Strong written and verbal communication skills and overall initiative are required. Professional registration desirable. Please send resume, references, salary and bonus commensurate with training, experience, and productivity. Ownership participation anticipated. Send letter of interest, resume, sample key reports or reprints to:

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The Mark Group

7205 West Coley Avenue

Las Vegas, Nevada 89117

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**Research Assistant Professor/Shallow Water Sedimentation.** A two-year, non-tenure track appointment is available at Dartmouth College. Primary emphasis is on research in hydrodynamic and water quality simulation for estuaries, lakes, and coastal waters. The position also involves teaching one course per semester. Additional opportunities exist for involvement in Geophysics, Numerical Methods, or Cold Regions Programs.

Applicants must hold the Ph.D. in any relevant scientific discipline. Ability with finite elements and/or boundary elements is strongly favored.

Desired start date is October 1, 1984. Renewal of initial appointment is possible, contingent upon successful completion of additional research funding. Send resume with three references and dissertation abstract by August 10 to:

Professor Daniel R. Lynch

Thayer School of Engineering

Dartmouth College

Hannover, New Hampshire 03755

Dartmouth College is an EEO/AA employer.

**University of Cambridge/Theoretical Sedimentology.** It is hoped soon to appoint a postdoctoral fellow to work independently in the general field of theoretical sedimentology. An interest in seismic modelling and interpretation, particularly of body-waves, would be suitable. Stimulating environment with other theoretical, reflection and refraction and earthquake seismologists. University salary. Send curriculum vitae to Professor C.H. Chapman, Bullard Laboratories, Department of Earth Sciences, University of Cambridge, Madingley Road, Cambridge CB3 0EZ, England, by 31 July 1984.

**Faculty Research Assistant.** Position is in the Department of Meteorology, University of Maryland, College Park. Opportunity to work with faculty in a number of research studies involving climate modeling, satellite profiles, and mesoscale analysis. Special emphasis on graphical output from computer models, and diagnostic routines using meteorological data, including satellite and radar imagery. Graphics development will be done on a local microcomputer network and remote host computer. Applicant must be working currently in area of computer science, applications programming and meteorology. BS in Computer Science or Meteorology. BS in Computer Science or Meteorology. Salary negotiable within range of \$18,000 to \$30,000. Contact Dr. David Rosenbloom, Department of Meteorology, University of Maryland, College Park, MD 20742; telephone 301-454-2708. Applications received before July 15, 1984 will receive full consideration.

The University of Maryland subscribes to a policy of equal educational and employment opportunity. The University of Maryland under Title IX of the education amendment of 1972, does not discriminate on the basis of sex in admission, treatment of students or employment.

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Based on papers from a symposium at the Woods Hole Oceanographic Institution, this book reevaluates the concept of a uniformitarianism based only on events and processes familiar in human experience and makes it clear that a radical expansion of that concept is needed to account for striking discontinuities in geology, paleontology, and climatology.

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**Assistant Research Geophysicist.** The Institute

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surements, a demonstrated capacity to design and

construct equipment, and the ability to carry out

experiments at sea. A Ph.D. in geophysics or related

sciences is required. Candidates should have some

experience with the analysis and interpretation of

EM data. Salary range is \$25,100-\$36,100. Applicants

must submit a resume, copies of relevant publica-

tions, and the names of three references by 1

July 1984 to:

Dr. Alan Chave

University of California, San Diego

Institute of Geophysics and Planetary Physics

La Jolla, CA 92093.

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**Postdoctoral Fellow in Igneous Petrology.** Avail-

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Please send resume, brief summary of research

goals and the names of three persons who may be

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L.A. Taylor

University of Tennessee

Department of Geological Sciences

Knoxville, TN 37996

Telephone: 615-974-6013

**Research Geophysicist/U.S. Geological Survey.**

The Office of Earthquake, Volcanic, and Engi-

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Branch of Tectonophysics carries out a vigorous

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345 Middlefield Road, ME 977

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**statement of teaching and research plans and three**

**letters of recommendation to Chairman, Appoint-**

**ments Committee, Department of Marine Sciences,**

**University of Puerto Rico, P.O. Box 9000, San**

**Juan, P.R. 00925-9000. Closing date for applica-**

**tions is July 1, 1984.**

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University of Puerto Rico, Mayaguez, P.R. 00708.

Telephone 809-832-1040, ext. 3443.

**Research Associate/Brown University.** Research

Associate in Planetary Geology at Brown University.

Providence, Rhode Island. Experience in geologic

geomorphic analysis of planetary images, study of

surface geologic processes, computerized image

processing, and/or quantitative geomorphology is

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1984. Submit resume, names and addresses of three

references to Dr. James Head, Box 1846, Brown

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**STUDENT OPPORTUNITIES**

**Special Doctoral Research Assistantships.** The

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Ronald E. Johnson, Graduate Program Director,

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niversity, Norfolk, VA 23508.

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## Meetings

### Announcements

#### AGU Fall Meeting: Hydrology Sessions

##### History of Hydrology: Earth Science Aspects

The AGU History and Heritage of Hydrology Committee is organizing a special session on historical aspects of the geologic and geochemical study of surface water and ground water at the AGU 1984 Fall Meeting in San Francisco, December 9-7.

Because this is a first-time effort by the Committee, no restrictions on scope have been imposed in order to span a range of interests within AGU and the hydrology community in general. Areas of interest include the work of individual scientists, the evolution of concepts, and the development of techniques and methodologies. Invited papers deal with the development of equations of unsaturated flow in soils, the work of Henry Darcy, and the interfacing of historians and scientists.

Abstracts, in standard AGU format, should be sent to Edward R. Landis, U.S. Geological Survey, 413 National Center, Reston, VA 22092 (telephone: 703-860-6971) by August 15, the special session deadline. In addition, an original and two copies should be sent to Fall Meeting, AGU, 2000 Florida Avenue, N.W., Washington, DC 20009, by the September 12 abstract deadline.

##### Statistical and Hydrological Criteria in the Safety of Dams

The AGU Surface Runoff Committee is organizing a special session on dam safety at the AGU 1984 Fall Meeting in San Francisco, December 9-7.

During the last few years, research has been directed toward the analysis of risks and uncertainties, risk-based design, and analysis of statistical, geotechnical, and hydrologic issues in the safety of dams. This session shall focus primarily on risk and hydrological factors associated with the design and safety of dams. Papers are solicited dealing with risk-based design, quantification of risks, uncertainties and probabilities of failure, stochastic aspects of reservoir operation related to flood control and dam safety, dam break problems, and hazard identification. General papers dealing with the mechanics of flow in dam-break situations may be accepted for presentation. The focus of the session will, however, be on risk and reliability aspects of dam safety. Invited papers deal with the use of random field models, probabilistic risk analysis, determination of the composite risk of failure, risk-based design, reservoir operation and dam safety, and relationships of failure probabilities to earthquakes and flood insurance.

Those interested in participating should send an abstract, in standard AGU format, to Ned Andrews, U.S. Geological Survey, Box 25046, MS 413, DFC, Denver, CO 80225 by August 15, the special session deadline. In addition, an original and two copies must be sent to Fall Meeting, AGU, 2000 Florida Avenue, N.W., Washington, DC 20009, by the September 12 abstract deadline.

##### Snowmelt-Runoff Modeling

A special session entitled "Advances in Snowmelt-Runoff Modeling" will be held during the AGU 1984 Fall Meeting in San Francisco, December 9-7. The half-day session is sponsored by the Snow and Ice Committee of the Hydrology Section. Topics addressed will include (but are not limited to) the use of new technologies in snowmelt-runoff forecasting, the WMO project on intercomparison of snowmelt-runoff models, comparison of temperature-index with energy budget models, and remote sensing measurement of snow parameters.

Abstracts, in standard AGU format, should be sent to Albert Rango, Hydrology, USDA/ARS/BARC-WEST, Building 007, Room 139, Beltsville, MD 20705, by August 15, the special session deadline. In addition, an original and two copies should be sent to Fall Meeting, AGU, 2000 Florida Avenue, N.W., Washington, DC 20009, by the September 12 abstract deadline.

##### Paleoflood Hydrology

The AGU Surface Runoff Committee is organizing a special session on paleoflood hydrology for the AGU 1984 Fall Meeting in San Francisco, December 9-7.

Paleoflood hydrology deals with the determination and use of naturally recorded flood data. This data may be obtained from many sources including tree rings, fluvial deposits, land forms, soils, and vegetative cover and may be used to date and quantify events dating back hundreds to thousands of years. Such long-term information may be essential in evaluating flood hazards and risks in a number of situations for which only relatively short, or no gauge records are available. The purpose of this session is to foster interest in, and awareness of, paleoflood hydrology by providing a forum for interdisciplinary communication of recent research and applications.

A partial list of invited speakers and proposed presentation titles for this special session includes Brian Atwater, "Magnitude and Frequency of Floods from Glacial Lake Mazatzal"; Victor Baker, "Recent Paleoflood Hydrology Studies in Arid and Semi-Arid Environments"; John Costa, "Fluvial Paleoflood Hydrology"; Cliff Hupp, "Dendro-Geomorphic Evidence and Interpretation of Historical Recent Debris Flows and Floods, Magnitude and Frequency"; Robert Jarrett, "Evaluation of Paleoflood-Flow Estimates in High-Gradient Streams"; Craig Kochel, "Paleofloods in Southwest Texas"; Jurate Landwehr and Nicholas Matalas, "Do Denudation Records Exhibit Long Memory?"; Michael Nolan and J. M. Donnelly, "Catastrophic Flooding Related to a Sub-Glacial

Eruption of Medicine Lake Volcano." Contributed papers are also solicited. Abstracts, in standard AGU format, should be sent to David Froelich (the session organizer), U.S. Geological Survey, Gulf Coast Hydroscience Center, Building 2101, NSTL, MS 99529 (telephone: 701-688-1529) by August 15, the special session deadline. In addition, an original and two copies should be sent to Fall Meeting, AGU, 2000 Florida Avenue, N.W., Washington, DC 20009, by the September 12 abstract deadline.

##### Symposium on the Fluvial Transport of Sediment-Associated Contaminants

Contamination of fluvial and estuarine sediments by toxic substances is a growing public policy and geochemical issue in recent years. Incidents such as discharges at Times Beach, Missouri; kepone in the lower James River, Virginia; and PCBs in Hudson River sediments and water have received widespread attention by federal, state, and local agencies and by the general public.

Present knowledge of toxic substances in the nation's surface waters is deficient in three main ways: (1) little is known about the nationwide occurrence, magnitude, and distribution of toxic substances on sediment particles and how these are changing with time; (2) there is limited understanding of the physical, chemical, and biochemical processes that govern the movement and fate of different types of toxic substances under different hydrologic conditions; (3) there is uncertainty about the best study approaches, sampling techniques, and measurement methods for obtaining information about different types of toxic substances in different hydrologic situations. These deficiencies result in crucial gaps in the knowledge necessary to safeguard human health and to protect fish and wildlife resources.

A symposium considering the fluvial transport of sediment-associated contaminants is being organized for the 1984 Fall Annual Meeting to be held in San Francisco, December 9-7. The symposium will examine (1) the hydrologic, chemical, and biological processes that influence the movement and fate of toxic substances; (2) development of improved methods for field sampling and laboratory analysis of toxic substances on sediments; and (3) detailed investigations of river basins and estuaries that describe the occurrence, magnitude, and distribution of different types of toxic substances in various hydrologic environments.

Those interested in participating should send an abstract, in standard AGU format, to Ned Andrews, U.S. Geological Survey, Box 25046, MS 413, DFC, Denver, CO 80225 by August 15, the special session deadline. In addition, an original and two copies must be sent to Fall Meeting, AGU, 2000 Florida Avenue, N.W.,



